

EX PARTE OR LATE FILED

RECEIVED

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Fig. 2. *Chloroform* rec'd 0

RECEIVED

JUN 12 2003

June 12, 2003

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

The Honorable Michael K. Powell
Chairman
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

The Honorable Michael J. Copps
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

The Honorable Kathleen Q. Abernathy
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

The Honorable Kevin J. Martin
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

The Honorable Jonathan S. Adelstein
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Re: *In the Matter of AT&T Corp. Petition for Rulemaking To Reform Regulation Of Incumbent Local Exchange Carrier Rates For Interstate Special Access Services*,
RM Docket No. 10593.

Dear Mr. Chairman and Commissioners:

The Special Access Reform Coalition (SPARC) funded a macroeconomic analysis of the impact on the U.S. economy if excessive special access prices were lowered to reasonable levels from their currently unjust and unreasonable levels. This study demonstrates that swift Commission action reducing special access rates to levels that would produce an 11.25% return historically allowed local exchange carriers, would result in immediate positive benefits by adding \$14.5 billion to the U.S. economic output (Gross Domestic Product) and by creating 132,000 new jobs in the first two years. The complete study entitled "Macroeconomic Benefits from a Reduction in Special Access Prices" is attached. Given the compelling evidence contained in this analysis, SPARC again urges the Commission to lower inflated special access rates immediately.

Respectfully submitted,

C. Douglas Jarrett, Partner
Keller and Heckman, L.L.P.
American Petroleum Institute

Leonard J. Cali
Vice President – Law & Director of Federal
Government Affairs
AT&T Corp.

Douglas I. Brandon
Vice President – External Affairs & Law
AT&T Wireless

Audrey Glenn
Director – Domestic Regulatory Affairs
Cable & Wireless

H. Russel Frisby Jr.
President
**CompTel (The Competitive
Telecommunications Association)**

Brian R. Moir, Partner
Moir & Hardman
**E-Commerce & Telecommunications
Users Group**

Donna Sorgi
Vice President
Federal Advocacy
MCI

Marc S. Martin
Kelley Drye & Warren LLP
Nextel Communications

Macroeconomic Benefits from a Reduction in Special Access Prices

**Paul N. Rappoport
Lester D. Taylor
Arthur S. Menko
Thomas L. Brand**

June 12, 2003

Table of Contents

Section I - Introduction

Section II - Study Process Overview

Section III - Price Elasticity

Section IV - Macroeconomic Model

Section V - Results of Macroeconomic Simulation

Section VI - Conclusion

Appendices:

Appendix 1 - Credentials of Study Authors

Appendix 2 – List of Companies included in the ROR Calculation

Appendix 3 – Special Access Rate of Return and Telecommunications Price Level Reduction

Appendix 4 – Price and Quantity Index Methodology

Appendix 5 – Price Elasticity Statistical Analysis

Appendix 6 – Investment Share of National Output

Appendix 7 – Macroeconomic Model – A General Description

Appendix 8 – Macroeconomic Simulation Results by Industry Group

I. Introduction

A macroeconomic study was performed to show the benefits to the U.S. economy of lowering the rates charged by Regional Bell Operating Companies (RBOCs) and other large incumbent local exchange carriers (ILECs) for interstate special access service.¹ The rates were lowered to a level that would still provide these companies with an 11.25% rate-of-return on total investment.² Special access service consists of the dedicated lines that run from a customer's location directly to a service provider's facilities without going through a local exchange company's switch. Special access is used extensively by large and small business customers, government agencies, and communications providers (including wireless and wireline carriers, broadband service providers, ISPs, and local, long distance and international service providers). A reduction in Special Access prices of 42%, commensurate with an 11.25% rate-of-return on total investment, would generate 64,000 new jobs and \$11.6 billion in new economic activity in the first year alone. The total accumulated number of new jobs created would double to 132,000 in the second year as the benefits of the price reduction flows through the economy.

The study was performed using a leading commercially available macroeconomic model to simulate the impact of special access price reductions on the U.S. economy.³ In the past, the RBOCs have used similar commercially available macroeconomic models to assess potential national economic impacts from proposed changes in telecommunication policy.⁴ The analysis presented here relies on publicly available special access revenue and volume

¹ The credentials of the authors of this study are provided in Appendix I.

² The 11.25% ROR was the last authorized ROR for price cap carriers prior to the initiation of price cap regulation in 1990, and is still used as the benchmark for smaller carriers under rate-of-return regulation.

³ Global Insight's U.S. Economic and U.S. Industry models were used to simulate the economic impacts presented in this document. Global Insight did not, however, provide the assumptions that underlie the simulation.

⁴ The RBOCs and AT&T used the commercially available WEFA macroeconomic model to simulate the effect of RBOC entry into the long distance interLATA telecommunications market. Two studies financed by the Bell companies include: WEFA Group, The Economic Impact of Deregulating U.S. Communications Industries, (Bala Cynwyd, Pennsylvania, February 1995). This study extends an earlier WEFA Group report, The Economic Impact of Eliminating the Line-of-Business Restrictions on the Bell Companies, (Bala Cynwyd, Pennsylvania, July 1993).

WEFA studies submitted in state regulatory proceedings include: Public Utility Commission of Texas, Investigation of Southwestern Bell Telephone Company's Entry into the InterLATA Telecommunications Market, Project No. 16251, 1998, Affidavits of Michael Raimondi and Jon. E. Hockenyoys submitted by Southwestern Bell; The State Corporation Commission of the State of Kansas, In The Matter of Southwestern Bell Telephone Company of Kansas' Compliance With Section 271 of the Federal Telecommunications Act of 1996, Docket No. 97-SWBT-411-GIT, 1998, Affidavits of Michael Raimondi and Anthony L. Redwood submitted by Southwestern Bell; BellSouth Long Distance, Inc., Direct Testimony of Michael Raimondi before the Georgia Public Service Commission, Exhibit I, Docket No. 6863-U (January 3, 1997); The Economic Impact of Immediate Competition in Long Distance Services in Georgia, prepared by the WEFA Group, December 1996.

data that the RBOCs and other large ILECs, hereinafter collectively referred to as ILECs, provide to the Federal Communications Commission (FCC).⁵

The existing rates for interstate special access give the ILECs profits that greatly exceed the 11.25% rate-of-return (ROR) for interstate services that the FCC uses as its benchmark. Rates of return have been rising steadily since the mid nineties for the ILECs. As a group, their ROR was 39.7% in 2002 on total revenues of \$13.3 billion.⁶

As increasing portions of the service have been removed from FCC price regulation during the past three years, special access has become particularly profitable for the local phone companies, as shown in the following table:

Year	ILECs' Special Access Rate-of-Return
2000	29.3%
2001	38.9%
2002	39.7%

The study simulated the impact of reducing the ILECs' special access prices by 42% (which amounts to \$5.6 billion on 2002 revenues) in order to produce an 11.25% rate of return. The downstream effect of this price reduction on all industry sectors was quantified by the macroeconomic model. If this price reduction had gone into effect at the start of 2003,⁷ it would have the effect of adding 132,000 jobs and \$14.5 billion in real Gross Domestic Product (GDP)⁸ to the U.S. economy as shown in the following table:

	Impact on U.S. Economy in 2003	Cumulative Impact on U.S. Economy in 2004
Employment	64,000 Jobs	132,000 Jobs
Real GDP	\$11.6 Billion	\$14.5 Billion

These benefits to the U.S. economy will be achieved without a loss of revenue by the ILECs. Because the demand for special access is quite sensitive to price, as shown in

⁵ A list of the RBOCs and other large ILECs included in this analysis is provided in Appendix 2. Data were used from the RBOCs' and other reporting ILECs' annual ARMIS reports (filed in April) and Price Cap Tariff Review Plans (filed in conjunction with the ILECs' annual interstate access tariff).

⁶ The ROR calculations are provided in Appendix 3. Since Qwest has been given an extension to submit its 2002 financials, its 2001 results were used in this calculation.

⁷ The primary effect of the implementation of the rate reductions occurs after the start of 2003 due to the lag effect that a change in prices has on other macroeconomic variables.

⁸ Real Gross Domestic Product is the value of final goods produced within the United States measured in constant dollars.

Section III below, price reductions are offset by the increase in demand stimulated by the reduced prices, such that the ILECs' total revenues remain about the same.

An overview of the study process is presented in Section II. The development of special access price elasticities, the macroeconomic model and the results of the macroeconomic simulation are described in Sections III, IV, and V of this paper, respectively.

II. Study Process Overview

The effect on the U.S. economy of decreasing the rates for interstate special access services provided by the ILECs was determined by utilizing a commercially available national macroeconomic model.⁹ Based on the 2002 ARMIS revenue, cost and net investment data filed by the ILECs in April 2003,¹⁰ it was estimated that a rate decrease of 41.9%, corresponding to a revenue decrease of \$5.6 billion, would reduce the aggregate rate-of-return on interstate special access to 11.25%.¹¹ The special access rate decrease was used to develop the associated change in telecommunications prices and the economy-wide investment stimulation that were input to the macroeconomic model. The resultant increases in employment and real GDP were the primary outputs of the macroeconomic model.

The study was performed in two phases. The elasticity of the demand for special access services with respect to price was developed in Phase I. The linkage between changes in special access prices and demand and other inter-industry changes and the resultant affect on economic output and employment were developed with the national macroeconomic model in Phase II. Charts 1 and 2, shown on pages 7 and 8 below, are flowcharts of the Phase I and II processes, respectively.

In Phase I, special access demand price elasticity models were developed for DS-0, DS-1 and DS-3 plus higher bandwidth services. Special access prices and a proxy variable to capture data/voice trends were used as explanatory variables in the demand equation for special access volumes (expressed in terms of quantity indices for each bandwidth).¹² The elasticities were developed based on publicly available special access revenue and volume

⁹ Global Insight's U.S. Economic and U.S. Industry models, hereinafter referred to as the macroeconomic models, were used to simulate the economic impacts presented in this document. Global Insight did not, however, provide the assumptions that underlie the simulation.

¹⁰ ARMIS data for 2002, 43-01 Report, Table 1, Cost and Revenue Table, Special Access Column., filed April 2003.

¹¹ This calculation is provided in Appendix 3.

¹² A description of the methodology used to calculate the price and quantity indices is provided in Appendix 4.

data that the ILECs have provided to the FCC.¹³ The output from this phase consists of a set of special access demand functions and demand elasticities. Based on these analyses, it was concluded that the use of an overall price elasticity for special access of -1.0 is reasonable and conservative.¹⁴ This estimate was thus used in the simulation.¹⁵

In Phase II, the change in special access prices was used to develop the change in the price of telecommunication services as a whole. Lowering special access prices leads to a direct stimulation of output in the communications sector. This change is dependent on the magnitude of the special access price elasticity, where an elasticity of -1.0 implies that a price reduction of \$5.6 billion causes an equivalent \$5.6 billion increase of special access output. The macroeconomic inter-industry model was then used to compute the direct and indirect impact that the change in the price of telecommunication services would have on all other output prices. The change in these output prices leads to changes in final demand prices.¹⁶

The reduction in special access prices produces \$5.6 billion in savings to firms that benefit directly or indirectly from special access services. *Since these firms are paying less for telecommunications services, they will turn those savings into investments for equipment and structures or other expenditures.* The conservative assumption was made that only a portion of this \$5.6 billion savings, amounting to 27% (based on historical and projected economic data), would be invested in additional plant or equipment.¹⁷

The downstream effect of the changed final demand prices and the investment stimulation results in changes to aggregate demand and hence to aggregate employment. The overall magnitude of the macroeconomic changes from these effects is based on the sum of all direct and indirect changes. The change in aggregate output is apportioned to individual industries by linking the output from the national simulation back to the inter-industry model. The results of the simulation are described in detail in Section V.

¹³ Data were used from the RBOCs' and other reporting ILECS' annual ARMIS and Price Cap Tariff Review Plan filings.

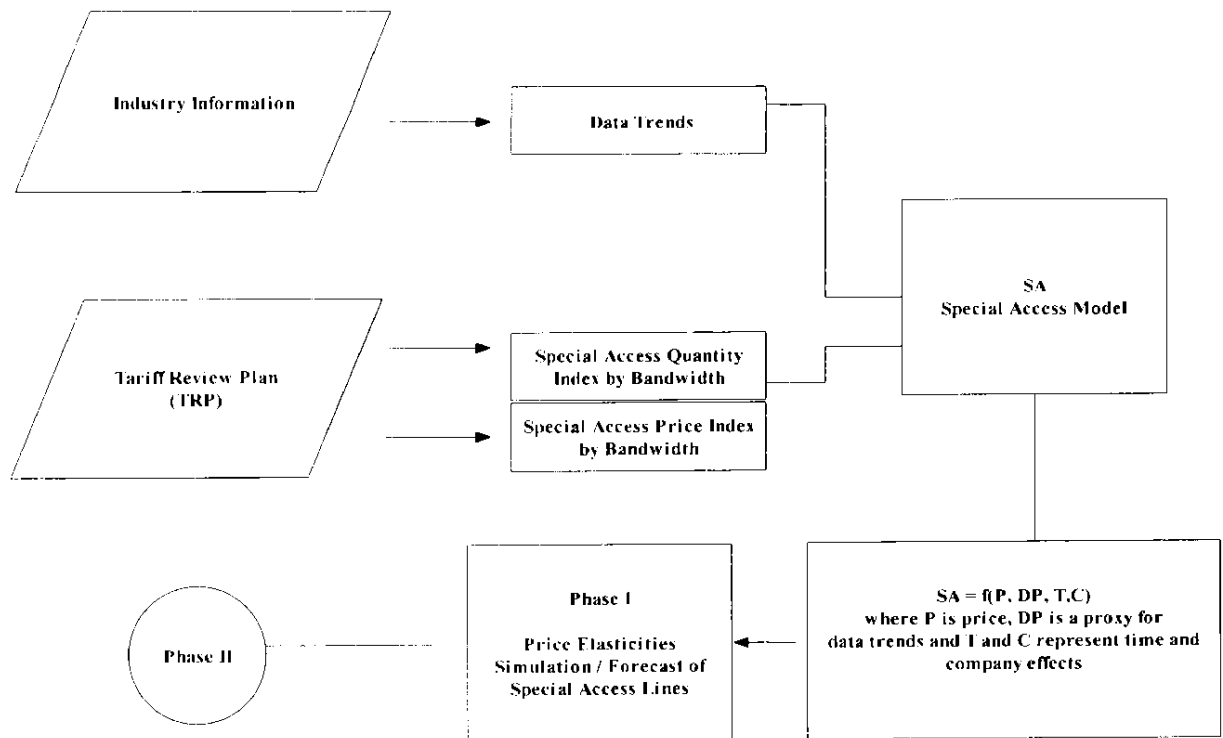
¹⁴ The use of an elasticity of -1.0 is conservative because higher elasticity values, which would have caused a greater stimulation in jobs and real GDP, were statistically significant as described in Section III.

¹⁵ The analysis used to develop the price elasticities is described in Section III and the results are provided in Appendix 5.

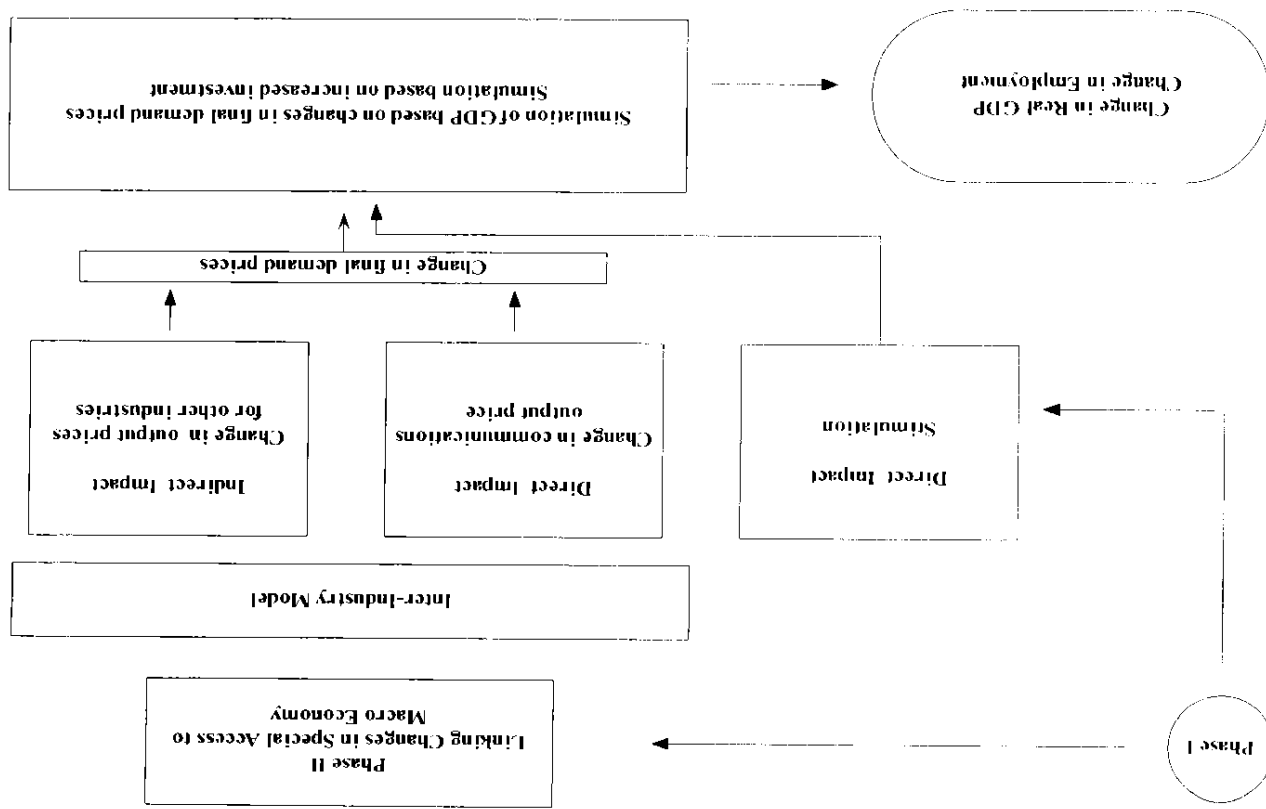
¹⁶ The final demand price is the price for a product or service that is not used as an input in an intermediate stage of production.

¹⁷ The calculation of the investment share of national output is provided in Appendix 6.

Phase I: Demand for Special Access



Phase 2: Link Between Special Access and the Macro-Economy



III. Price Elasticity

3.1. Price Elasticity of Demand for Special Access Services

The estimation of the price elasticity for special access services was based on traditional derived demand models where the special access quantity is specified as a function of price and other exogenous determinants. Our results indicate that a drop in special access prices will result in an equivalent or higher response in demand, especially for the higher bandwidth services.

There is a rich and comprehensive literature dealing with the demand for telecommunication services. One of the foremost economists in this area is Professor Lester Taylor¹⁸ of the University of Arizona, who served as an expert consultant to this study. In 1980 (updated in 1994), Dr. Taylor published his seminal survey on telecom demand modeling. These comprehensive studies are the standard sources for estimates on telecom elasticities. Professor Taylor reviewed the data series, the construction and specification of the underlying demand models and the estimated elasticities. He concluded that the use of an overall elasticity for special access of -1.0 is reasonable and conservative.

The primary issue in developing special access demand models is the collection of reliable data on special access prices and quantities. This study utilized quantity and price indices derived from data submitted by the ILECs as part of their annual ARMIS and Price Cap Tariff Review Plan filings.¹⁹ These data provided the means for specifying and estimating models of special access by bandwidth. Price and quantity indices were developed for the DS-1, DS-3 and above, and DS-0 (voice grade) services.

The general functional form of the demand for special access services is as follows:

$$SA_n = f(p, DP, T, C)$$

where SA is the demand for special access services at bandwidth DS_n, p is the price of special access at bandwidth DS_n, DP represents a proxy for the growth in data services,²⁰ T represents a set of dummy variables that capture specific year effects, and C denotes a set of dummy variables that capture specific firm effects. Special access equations are estimated for the three categories of special access service. The data set combines both cross-sectional and time series variation. The estimation procedure, which uses dummy

¹⁸ Professor Lester Taylor's credentials are provided in Appendix 1.

¹⁹ A description of the price and quantity indices derived from data submitted by the RBOCs as part of their annual Tariff Review Plans is found in Appendix 4.

²⁰ The RBOCs file the quantity of copper digital and fiber working channels to the FCC in the ARMIS 43-07 report. Copper digital and fiber working channels were summed to quantify digital working channels. Then digital working channels were divided by total working channels to express the share of working digital capable channels. Working channels include both subscriber access lines and the local channel portion of private line and special access services.

variables to capture specific time effects and company effects, is known as a fixed effects model or a least squares dummy variable model.

3.2 Database Construction for TRP Based Models

Price and quantity indices for the years 1993 through 2001 were obtained and derived from the TRPs (Tariff Review Plans) submitted by the Regional Bell Companies (RBOCs) in their annual access tariff filings. These indices were obtained for three categories of special access service:

- DS-0 (Voice Grade/WATS, Metallic, and Telegraph)
- DS-1 (1.544 Mbps)
- DS-3 (45 Mbps and above)

Price indices were obtained directly from the annual TRPs and consist of the “Existing SBIs” (Service Band Indices²¹) for the “VG/WATS, Metallic, Telegraph” service category and the DS-1 and DS-3 sub-categories.²²

Quantity indices were developed from the revenue data reported in the RTE-1 section of the TRPs. Revenue data shown in the RTE-1 form include “*Base period demand times Rates at last PCI update*” and “*Base period demand times Proposed rates*” for each service category and sub-category. By comparing the amounts shown for “*Base period demand times Rates at last PCI update*” in the current TRP with the amounts shown for “*Base period demand times Proposed rates*” in the previous year’s TRP, the change in demand from one year to the next for those services under price cap regulation was estimated and used to develop chain-linked quantity indices.²³

A ratio of digital working channels to total working channels was used in the models to proxy the substitution of data channels for voice grade channels, since it is the best available proxy variable for this study that is specific to the RBOC companies for the period between 1993 and 2001. This trend of a shift of voice channels to data channels is confirmed by the special access service indices, for which the quantity indices for DS-1 and DS-3 and higher bandwidth special access lines increased substantially over time, while the quantity index for DS-0 Voice Grade service declined significantly.

3.3 Estimated Price Elasticities

The price elasticities derived from the special access models are shown in the following table:

²¹ A definition of the SBIs and their derivation is provided in Appendix 4.

²² These indices, which are technically known as chain-linked Laspeyres indices, are calculated in accordance with Section 61.47(a) of the FCC’s rules, 47 C.F.R. § 61.47(a), and reported in the TRP filings.

²³ See Appendix 4 for a complete description of the special access price and quantity indices used.

Special Access Bandwidth	Elasticity
DS-0	Not Significant
DS-1	-1.31
DS-3 and above	-1.91

Special access DS-1 services, which represent the bulk of the special access revenues reported by the RBOCs,²⁴ yield an estimated elasticity of -1.31 that is statistically significant at the .01 level. The estimated elasticity for special access DS-3 services is higher than the estimate for DS-1 and is also similarly statistically significant. The model did not produce statistically significant results for voice grade DS-0 services. This result has little bearing on the overall result since DS-0 services represent only a very small fraction of special access revenues^{25 26}.

3.4. Conclusions on Price Elasticity of Special Access Demand

Using publicly available quantity and price information derived from data submitted by the RBOCs as part of their Tariff Review Plans, we have specified and estimated models of special access demand by bandwidth for the time period 1993 to 2001. These models produced statistically significant results that yielded elasticities for special access services that were considerably greater than -1.0 (-1.31 for DS-1 and -1.91 for DS-3 and above). These results indicate that a drop in special access prices will result in an equivalent or greater response in demand, especially for the higher bandwidth services. Professor Lester Taylor concluded that the use of an overall elasticity for special access of -1.0 , which is revenue neutral, is reasonable and conservative, particularly because there is sufficient evidence that would have justified use of a higher elasticity value.²⁷

²⁴ DS1 service accounted for 57% of total special access revenues, based on TRP data provided by the RBOCs in 2002.

²⁵ The Voice Grade/WATS, Metallic and Telegraph service category accounted for only 2.2% of total special access revenue in the RBOCs' 2002 TRP filings.

²⁶ The results of the statistical analysis performed to develop price elasticities are provided in Appendix 5.

²⁷ Changes in price produce a revenue neutral effect since an overall elasticity for special access of -1.0 yields an equal absolute percentage change in price and the quantity demanded. For example, if a box of paper costs \$50 and there is a demand for 1,000 boxes, the resulting revenue is \$50,000. If the price is reduced by 50% to \$25, it is expected, given an elasticity of -1.0 , that 2,000 boxes will be purchased, resulting in the same \$50,000 of revenue.

IV. Macroeconomic Model

4.1 Macroeconomic Process

The macroeconomic model uses a two-stage approach for linking changes in special access service prices and demand to other inter-industry changes, by industry. The total impact of the proposed change in special access services prices throughout the U.S. economy was analyzed based on U.S. economic and U.S. industry forecasting models.

The models provide a structure that leads to the quantification of the relationships among the various sectors of the economy. These relationships are linked through sets of assumptions and feedback loops to assure consistency across industries and economic aggregates.

The macroeconomic model simulation process utilizes the interaction between the U.S. economic and industry models. Special access service price assumptions are incorporated directly into the industry model to create inputs to the U.S. economic model. The industry model outputs drive the U.S. economic model and define the overall economic impact of the reduction in special access prices. The macroeconomic process works as follows:

- Changes in special access prices are entered into the industry model through changes in the output price index for the telecommunications service industry. This model uses an embedded input/output methodology to determine simultaneously consistent input and output industry prices. Since telecommunications products and services are used by all U.S. industries, changes in their prices will affect input costs and eventually output prices of all the end-use industries. The model generates an alternative set of final demand price deflators for input to the U.S. economic model.²⁸
- This set of final demand deflators maps directly into the U.S. macroeconomic model and yields a new U.S. economic forecast. This simulation adjusts total economic activity through the effects of prices on inflation, interest rates, wages, employment, income and final demand.

4.2 Incorporation of Special Access Price Reduction

Based on the price elasticity of -1.0 described in Section 3 above, an x% reduction in special access prices will yield an x% increase in special access demand. A price reduction of 42%, estimated to produce an aggregate 11.25% interstate rate of return, will result in approximately a \$5.6 billion direct effect on the telecommunications industry, reducing the

²⁸Final demand deflators are price indices that are associated with the consumption of final goods and services. Final demand denotes a product or service that is not used as an input in an intermediate stage of production. Both the GDP Implicit Price Deflator and the Consumer Price Index can be thought of as final demand deflators. The macro model used in this simulation uses the GDP Price Deflator as the final demand price deflator.

price level of telecommunications services as a whole by about 5%.²⁹ This price change affects all other output prices. The impact of this change is captured in the input-output matrix component of the Inter-Industry model. A change in telecommunications prices leads to a reduction in the output prices for all other industries. These changes lead to changes in the final demand prices, which become "drivers" in the national macro model. In effect, this part of the model simulates a change in aggregate demand due to a decline in prices.

In addition, the special access price reduction provides \$5.6 billion in savings for those industries that use special access services. These savings are available to be used for other purposes. Based on the recent historical relationship of investment to business spending, it is estimated that 27% of these savings will be directed to investment in equipment and structures.³⁰

The change in aggregate real GDP is apportioned to individual industries by linking the U.S. economic model output back to the inter-industry model.

A technical description of the general macroeconomic process is provided in Appendix 7.

V. Results of Macroeconomic Simulation

The results of the simulation based on the decline in special access prices and the associated investment stimulation led to increases in employment, real GDP, and gross output and a decrease in the unemployment rate. The respective gains to specific industries' gross output were developed using the inter-industry model to apportion the aggregate change in output.

The macroeconomic results for 2003 through 2005 were as follows:³¹

Year	Cumulative Change in Employment	Cumulative Change in Real GDP	Change in Gross Output ³²
2003	64,000	\$11.6 Billion	\$35.6 Billion
2004	132,000	\$14.5 Billion	\$49.7 Billion
2005	130,000	\$13.5 Billion	\$46.0 Billion

²⁹ The price level of telecom services (Other Communication Services Price Index SIC: 481-2 and 484-9) is based on the aggregation of the following revenue accounts from the FCC Statistics of Communications Common Carriers: local services, access services, uncollectibles, intra-LATA toll and miscellaneous revenues. The calculation of the 5% price level reduction is found in Appendix 3.

³⁰ Refer to Appendix 6 for the calculation of the investment share of business spending.

³¹ The changes in employment, real GDP and gross output are with respect to a baseline economic scenario that does not include the special access price decrease.

³² Gross Output is the value of total shipments, which include intermediate sales in addition to final sales of goods and services.

The special access price decrease, assumed to be effective on January 1, 2003, increases total employment by 64,000 jobs in 2003, which peaks to a total gain of 132,000 jobs in 2004. The cumulative increase in real GDP will be \$11.6 billion in 2003 and \$14.5 billion in 2004. The cumulative increase in gross output will be \$35.6 billion in 2004 and \$49.7 billion in 2005. Because of the time it takes for the stimulation to propagate through the U.S. economy, the full effect of the price decrease on employment, real GDP and gross output does not occur until 2004. After 2004, the stimulation effect will level off and then decline slightly in 2005 as the economy comes to equilibrium after the initial impact of the price decrease.

The changes in gross output for manufacturing and non-manufacturing industries, by general industry categories, were simulated in the inter industry model. The results are shown in the following table:

Increase in Gross Output By Industry Sector³³
In Billions of Dollars

Industry	2003	2004	2005
Manufacturing	5.53	8.91	7.22
Construction & Mining & Agric.	1.77	2.95	2.86
Finance, Insurance, RE	1.90	2.96	2.97
Services	4.25	6.34	6.02
Trade – Retail & Wholesale	2.85	4.31	3.92
Transportation & Utilities	19.29	24.22	23.00
Total Gross Output	35.58	49.69	45.98

Gross output will be stimulated across many industry groups, with the largest increase occurring in the transport and utilities sector. The increases in gross output by two-digit industry group are provided in Appendix 8.

The above estimates of the beneficial effects on the U.S. economy are conservatively low for the following reasons:

- a. A price elasticity of -1.0 was used to calculate the increased demand that results from the special access rate decrease, even though analyses showed statistically significant elasticities of greater than -1.0.
- b. The study was based only on the major ILECs listed in Appendix 2. Any corresponding rate reductions by smaller ILECs, CLECs, and other independents that operate in the same or contingent areas as the major ILECs would increase these beneficial effects.

³³ Gross output gains (GDP and all other purchases) are relative to the baseline economic scenario.

c. Rates were reduced based on the costs filed by the ILECs to produce an 11.25% ROR before accounting for the effect of any demand stimulation. Greater rate decreases and larger benefits would occur if rates were reduced to produce a lower, more realistic ROR in line with the ILECs' current cost of capital or if the rates were determined based on the ILECs' economic TELRIC costs.

The above benefits to the U.S. economy will be achieved without a loss of revenue by the ILECs. With a price elasticity of -1.0, price reductions are offset by the increase in demand stimulated by the reduced prices, so that ILECs' total revenues remain the same.

VI. Conclusion

The macroeconomic simulation shows that the benefits to the U.S. economy of reducing the ILECs' interstate special access rates will be significant. There will be an immediate boost in jobs in the first year that doubles in the second year. There will also be a significant increase in real GDP and gross output.

Appendices

Appendix 1 - Credentials of Study Authors

Appendix 2 – List of Companies included in the ROR Calculation

Appendix 3 – Special Access Rate of Return and Telecommunications Price Level Reduction

Appendix 4 – Price and Quantity Index Methodology

Appendix 5 – Price Elasticity Statistical Analysis

Appendix 6 – Investment Share of National Output

Appendix 7 – Macroeconomic Model – A General Description

Appendix 8 – Macroeconomic Simulation Results by Industry Group

Appendix 1

Credentials of Study Authors

Paul N. Rappoport is Associate Professor of Economics at Temple University. He is also a principal and senior academic consultant with the economics consulting firm, Econsult. He has over 25 years of experience in data analysis, modeling and statistical assessment, with a specialization in telecommunications demand analysis. He was responsible for the development of Bill HarvestingTM, a national database of actual communications bills, a small business panel – which focused on telecommunications and energy – and a large consumer national telecommunication database. Collaborating with Professor Lester Taylor, Dr. Rappoport has constructed and estimated demand models and elasticities for a wide array of consumer and business telecommunication products and services. His current research interests include: the construction of internet metrics; modeling the Digital Divide; specifying and modeling business broadband; forecasting internet demand and measuring the nature of network externalities. He received his Ph.D. from The Ohio State University in 1974.

Lester D. Taylor is currently Professor of Economics and Professor of Agricultural & Natural Resource Economics at the University of Arizona. He has a Ph.D. in economics from Harvard University, and taught at Harvard and the University of Michigan before taking up residence in Arizona in 1972. During the spring semester of 1996, he taught at Charles University in Prague in the Czech Republic. His research in telecommunications covers more than 25 years, and has published extensively on telecommunications demand, pricing, and costing. His most recent book, *Capital, Accumulation, and Money*, was published in 2000. His most recent book in telecommunications, *Telecommunications Demand in Theory and Practice*, was published in 1994. He has also recently co-edited, with David G. Loomis, *The Future of the Telecommunications Industry: Forecasting and Demand Analysis* and *Forecasting the Internet: Understanding the Explosive Growth of Data Communications*.

Arthur S. Menko has 25 years of experience in the telecommunications industry. He has been President of Business Planning, Inc. since 1985. Business Planning, Inc. provides international telecommunications consulting services in the following areas:

- Regulatory and financial analyses of local exchange carriers.
- Benchmarking and best practices analyses.
- Communication surveys and databases development.
- Statistical and industry analyses for the telecom industry.

Prior to Business Planning, Inc., Mr. Menko was a Senior Economist at Chase Econometrics and a Forecast Manager at New York Telephone. As a Senior Economist, he produced communications industry forecasts of the telecommunications services and equipment markets and developed econometric models for regulatory and rate making purposes. While at New York Telephone he developed statistical models of short and long-term forecasts to support operational, financial and planning departments. He has an MBA from New York University and a BA in Economics from Lehigh University.

Thomas L. Brand has had over 30 years of experience in the telecommunications industry. Mr. Brand has worked for AT&T and Bell Telephone Laboratories. He is currently an independent consultant to the telecommunications industry. He has performed extensive research and analysis of numerous aspects of the telecommunications industry. His experience includes the following areas of analysis:

- Regulatory, financial and competitive analyses of the interexchange carrier and local exchange carrier industries.
- Business case analysis and business strategy development and implementation for communications services.
- Statistical analyses of numerous aspects of the telecommunications industry including local and long distance services.
- Econometric analyses of the telecom industry.

He has provided expert testimony before state public utility commissions on topics that include the economic impact of Regional Bell Operating Company entry into the long distance business, price caps for telecommunications carriers, universal service policy and Unbundled Network Element costs. Mr. Brand has also provided expert analysis for numerous proceedings before the FCC. He has a Master of Business Administration from The Wharton School, University of Pennsylvania, a Master of Science in Statistics from Rutgers University, a Master of Science in Electrical Engineering from Columbia University and a Bachelor of Electrical Engineering from the City College of New York (CCNY).

Appendix 2

List of Companies by Jurisdiction included in the ROR Calculation

BellSouth-Florida	Verizon-Washington D.C.
BellSouth-Georgia	Verizon-Maryland
BellSouth-North Carolina	Verizon-Virginia
BellSouth-South Carolina	Verizon-West Virginia
BellSouth-Alabama	Verizon-Delaware
BellSouth-Kentucky	Verizon-Pennsylvania
BellSouth-Louisiana	Verizon-New Jersey
BellSouth-Mississippi	Verizon NE - Maine
BellSouth-Tennessee	Verizon NE - Massachusetts
	Verizon NE - New Hampshire
Southwestern – Arkansas	Verizon NE - Rhode Island
Southwestern – Kansas	Verizon NE - Vermont
Southwestern – Missouri	Verizon New York Telephone
Southwestern – Oklahoma	GTE California
Southwestern – Texas	Contel Arizona
Pacific Bell – California	Contel California
Nevada Bell	Contel Nevada
SBC/SNET - Connecticut	Verizon Florida
Illinois Bell	Verizon Hawaii
Indiana Bell	Verizon NO-Illinois
Michigan Bell	Verizon NO-Indiana
Ohio Bell	Verizon NO-Michigan
Wisconsin Bell	Verizon NO-Ohio
	Verizon NO-Pennsylvania
	Verizon NO-Wisconsin
Qwest-Arizona	Verizon NO-General Offices
Qwest-Colorado	Verizon NO-Contel/Pennsylvania
Qwest-Idaho South	Verizon NO-Contel/Quaker State
Qwest-Montana	Verizon NO-Contel/Indiana
Qwest-New Mexico	Verizon NO-Contel/Illinois
Qwest-Utah	Verizon NW-Idaho
Qwest-Wyoming	Verizon NW-Oregon
Qwest-Iowa	Verizon NW-Washington
Qwest-Minnesota	Verizon NW-West Coast California
Qwest-Nebraska	Verizon NW-Contel Washington
Qwest-North Dakota	Verizon SO-North Carolina
Qwest-South Dakota	Verizon SO-South Carolina
Qwest-Idaho North	Verizon SO-Virginia
Qwest-Oregon	Verizon SO-Illinois
Qwest-Washington	Verizon SO-Contel-North Carolina
	Verizon SO-Contel-South Carolina
Sprint - Florida, Inc.	Verizon SO-Contel-Virginia
Carolina Tel & Tel of North Carolina	Verizon SW-Texas
United SO-Tennessee	Verizon SW-Contel-Texas
United SO-Virginia	Verizon - Contel SO-Michigan
United Tel of Missouri	Verizon - Contel SO-Indiana

Central Tel Co. NC Divn.-NC/VA
Central Tel of Nevada Divn.-Nevada
United Tel of Texas
Central of Texas
United Tel of New Jersey
United Tel of Pennsylvania
United NW-Oregon
United NW-Washington
Central-Virginia
United Tel of Ohio
United Tel of Indiana

PRTC - Puerto Rico
PRTC - Puerto Rico Central

Alliant Telecommunications
Cincinnati Bell - Ohio
Cincinnati Bell - Kentucky
Citizens NY - Upstate
Citizens NY - Red Hook
Citizens NY - Western Counties
Rochester Telephone

Appendix 3

Special Access Rate of Return and Telecommunications Price Level Reduction

Return Data for Special Access (1)

(All Dollars are in Thousands)

	Total Operating Revenues	Average Net Investment	Net Return	Rate of Return	Revenue change for 11.25% ROR (3)	
2002 Price Cap LECs (except Qwest) (2)	\$11,812,805	\$10,547,793	\$4,096,331	38.8%	\$4,789,637	40.5%
Qwest 2001	\$1,528,226	\$1,407,245	\$646,769	46.0%	\$804,039	52.6%
Estimated 2002 Total Price Cap LECs	\$13,341,031	\$11,955,038	\$4,743,100	39.7%	\$5,593,676	41.9%
2001 Total Price Cap LECs	\$12,897,323	\$12,412,741	\$4,825,688	38.9%		
2000 Total Price Cap LECs	\$9,917,956	\$10,629,256	\$3,117,828	29.3%		

Notes:

1. Source: ARMIS 43-01, Table 1, Column S, Rows 1090, 1910, and 1915.
2. Price cap LECs include all price cap carriers that provide ARMIS 43-01 data. Because Qwest had not provided ARMIS 43-01 data for 2002 at the time of this report, Qwest's data for 2001 are used to calculate the aggregate LEC return for 2002.
3. Calculation based on a 39.25% marginal tax rate, with the revenue change calculated as follows:

$(ROR - 11.25\%) * ANI / (1 - 39.25\%)$, where ROR is the actual rate of return and ANI is average net investment. 39.25% is the composite tax rate currently used in the FCC's HCPM/HAI Synthesis Cost Proxy Model. (<http://www.fcc.gov/wcb/tapd/hcpm/welcome.html>)

Calculation of the Reduction in the Price Level of Telecommunications

The price level index for telecom services (Other Communications Services Price Index SIC: 481-2 and 484-9) is based on total ILEC revenues found in the FCC Statistics of Common Carriers.

For the year 2002 total ILEC revenues amounted to \$99.422 billion while interstate special access line revenues were \$11.813 billion, based on the FCC's ARMIS 43-01 reports.

Special access revenues thus comprise 11.9% of the total ILEC revenues (\$11.813 billion divided by \$99.422 billion). When the proposed special access price reduction of 42% is multiplied by the special access share of total revenues (11.9%), it yields an overall reduction in the price level of telecommunications services of approximately 5%.

Note: ILEC revenues in the ARMIS 43-01 report will approximate the revenues found in the FCC Statistics of Common Carriers when it is published with two exceptions:

1. The ARMIS revenues exclude Qwest, since they will not file their financial results until July 2003.
2. The ARMIS data includes additional price cap companies (see Appendix 2) that will not be included in the FCC Statistics of Common Carriers report.

Appendix 4

Price and Quantity Index Methodology

Price and quantity indices for interstate special access services are obtained from the TRPs (Tariff Review Plans) submitted by the Regional Bell companies (RBOCs) in their annual access tariff filings from 1993 through 2002. These indices are obtained for three categories of special access service:

- Voice Grade/WATS, Metallic, and Telegraph
- DS-1 (1.544 Mbps)
- DS-3 (45 Mbps and above)

Special Access Price Indices

Price indices are obtained directly from the annual TRPs and consist of the “Existing SBIs” (Service Band Indices) for the “VG/WATS, Metallic, Telegraph” service category and the DS-1 and DS-3 sub-categories. These indices, which are technically known as chain-linked Laspeyres indices, are calculated in accordance with Section 61.47(a) of the FCC’s rules, 47 C.F.R. § 61.47(a), and reported in the IND-1 section of the TRP filings.

The “Existing SBI” represents the level of rates in effect at the time of the annual tariff filings. In most cases, these rates have been in effect since July 1st of the previous year. The index value shown for the year “t” was obtained from the year “t” TRP and generally reflects the rates that were in effect from July 1st of the year “t – 1” until June 30th of the year “t”. Two things are worth noting about the indices used in this study:

- For the years 1994 through 1999, special access lines were combined with the dedicated lines used for switched access and reported within the same service categories and sub-categories, as part of the newly formed “Trunking” basket. The price indices for these years thus represent both special access and dedicated switched access (i.e., “direct-trunked transport”) services. In most cases, however, lines used for dedicated switched access were priced the same as lines used for special access, so that the price indices provide a reasonably accurate measure of the level of special access prices.
- For the years 1993 through 1998, price indices for Verizon were developed by combining the indices of Bell Atlantic and NYNEX, with the Verizon index calculated as a weighted average of the indices for the two companies. For the VG and DS1 categories, the weights were derived from the corresponding number of base year channel terminations for these services (as reported in the RTE-1 section of the TRPs). The 1993-1998 price indices for Verizon are thus:

$$P(VZ) = \frac{[CT(BA)*P(BA)] + [CT(NX)*P(NX)]}{CT(BA) + CT(NX)}$$

where P is the price index, CT is the number of channel terminations, VZ refers to Verizon, BA refers to Bell Atlantic, and NX refers to NYNEX. Because channel terminations and other quantities are not reported for DS3 services in the TRP, the same weights for DS1 service were used for DS3 service.

Special Access Quantity Indices

TRP data are used to develop indices that represent the quantities of each of the three special access categories. Because special access services are comprised of a diverse set of elements – channel terminations, interoffice links, interoffice mileage, and multiplexing, as well as various ancillary services – an index number approach is appropriate for measuring the quantity of special access in place. Chain-linked Laspeyres quantity indices can be developed from revenue data reported in the RTE-1 section of the TRPs. This type of index is conceptually similar to the chain-linked Laspeyres price indices that are calculated by the price cap LECs and used here.³⁴

Revenue data shown in the RTE-1 form includes “*Base period demand times Rates at last PCI update*” and “*Base period demand times Proposed rates*” for each service category and sub-category. By comparing the amounts shown for “*Base period demand times Rates at last PCI update*” in the current TRP with the amounts shown for “*Base period demand times Proposed rates*” in the previous year’s TRP, it is possible to estimate the change in demand from one year to the next for those services under price cap regulation.

For example, the 2002 TRP shows revenues calculated at the old rates (“rates at last PCI update” – i.e., July 2001) times 2001 base year demand. This can be compared to data in the 2001 TRP, which shows revenues calculated at what were then the new rates (“proposed rates” – effective July 2001) times 2000 base year demand. The difference between the two revenue figures is attributable to the change in demand from 2000 to 2001. The percentage change in revenue provides the basis for a Laspeyres quantity index, which is based on changes in revenue with prices held constant. These percent changes for successive years are then be linked together to form a chain-linked Laspeyres quantity index, with the index “I” for year *t* calculated by updating the index for year *t-1* as follows:

$$I(t) = \frac{I(t-1) * \sum Q(t) * P(t-1)}{\sum Q(t-1) * P(t-1)}$$

where Q and P refer to the quantities and prices of each rate element from which the TRP revenue figures are developed. The indices are initialized at 100 for the year 1993. From 1993 to 1999, the estimated demand changes include dedicated switched access, while the

³⁴ For further discussion of the Laspeyres index and the use of chain-linked indices, see Index Numbers in Theory and Practice (pp. 51-53, 177-182) by R. G. D. Allen (Macmillan Press, 1975).

changes from 1999 to 2001 are for special access only.³⁵

³⁵ Because the growth in dedicated transport for switched access was less than the growth in special access from 1993 to 1999, these calculations provide a conservative estimate of the growth in special access quantities for that period. In order to splice the 1993-1999 and 1999-2001 series together, dedicated switched access revenues were included in the revenue data for 1999 when calculating the changes in quantities from 1998 to 1999, but were not included when calculating the changes in quantities from 1999 to 2000.

Appendix 5

Price Elasticity Statistical Analysis

The underlying data represented a panel of observations with both a time dimension and a company dimension. This type of specification is referred to as a fixed effects of least squares dummy variable model, because specific time effects or company effects can be captured by using dummy variables.

The functional form used in the modeling of special access is generally referred to as a double-log functional form. In this specification, the dependent and independent variables are converted to natural logarithms. A useful property of the double log model is that the coefficient on the price term is an estimate of the price elasticity.

For the DS-1 and DS-3 models, the fixed effects for companies were insignificant. Time fixed effects were significant. The price terms were significant in both models. A summary of the regression analyses used to develop the price elasticities for DS-0, DS-1 and DS-3 special access services is provided in the following tables:

DS-1 Model

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.778(a)	.605	.564	.28859

a. Predictors: (Constant), D1999, LPDS1, D2000, D2001, LDCHAN

b. Dependent Variable: LQDS1

Where:

LQDS1 is the dependent variable. The DS-1 quantity index logged (the DS-1 quantity variable)

LPDS1 is the DS-1 price index logged (the DS-1 price variable)

LDCHAN is the ratio of digital working channels to total working channels logged. This is the proxy variable used to explain the shift from voice to data services. (Source: ARMIS 43-07)

D2000 is a dummy variable used to capture the effect on DS-1 quantities for the differential time trend in 2000.

D2001 is a dummy variable used to capture the effect on DS-1 quantities for the differential time trend in 2001.

ANOVA - Analysis of Variance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6.118	5	1.224	14.692	.000(a)
	Residual	3.998	48	.083		
	Total	10.115	53			

a. Predictors: (Constant), D1999, LPDS1, D2000, D2001, LDCHAN

b. Dependent Variable: LQDS1

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.855	2.240		4.845	.000
	LPDS1	-1.310	.507	-.237	-2.583	.013
	LDCHAN	.096	.062	.152	1.545	.129
	D2001	.539	.134	.392	4.026	.000
	D2000	.557	.132	.405	4.226	.000
	D1999	.716	.131	.520	5.479	.000

a. Dependent Variable: LQDS1

Estimated elasticity for DS-1 is -1.31 .

DS-3 Model

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.669(a)	.448	.390	.41347

a. Predictors: (Constant), LPDS3, D1999, LDCHAN, D2000, D2001

b. Dependent Variable: LQDS3

Where:

LQDS3 is the dependent variable. The DS-3 quantity index is logged.

LPDS3 is the DS-3 price index logged (the DS-3 price variable)

LDCHAN is the ratio of digital working channels to total working channels logged. This is the proxy variable used to explain the shift from voice to data services. (Source: ARMIS 4307)

D1999 is a dummy variable used to capture the effect on DS-3 quantities for the differential time trend in 1999.

D2000 is a dummy variable used to capture the effect on DS-3 quantities for the differential time trend in 2000.

D2001 is a dummy variable used to capture the effect on DS-3 quantities for the differential time trend in 2001.

ANOVA- Analysis of Variance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6.655	5	1.331	7.785	.000(a)
	Residual	8.206	48	.171		
	Total	14.861	53			

a. Predictors: (Constant), LPDS3, D1999, LDCHAN, D2000, D2001

b. Dependent Variable: LQDS3

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.846	2.015		6.873	.000
	LDCHAN	.108	.089	.141	1.220	.228
	D2001	.200	.196	.120	1.018	.314
	D2000	.214	.193	.128	1.110	.273
	D1999	.558	.188	.334	2.971	.005
	LPDS3	-1.908	.455	-.471	-4.197	.000

a. Dependent Variable: LQDS3

Estimated elasticity for DS-3 is -1.908.

DS-0 Model (Voice Grade)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.945(a)	.894	.853	.21508

a. Predictors: (Constant), RSW, D2001, LPVG, RBELLS, D2000, RVZ, RAM, RPBELLS

b. Dependent Variable: LQVG

Where:

LQVG is the dependent variable. The DS-0 (Voice Grade) quantity index is logged.

LPVG is the DS-0 (Voice Grade) price index logged (the DS-0 price variable).

D2000 is a dummy variable used to capture the effect on DS-0 quantities for the differential time trend in 2000.

D2001 is a dummy variable used to capture the effect on DS-0 quantities for the differential time trend in 2001.

RAM is a dummy variable used to capture individual effects experienced by Ameritech.

RVZ is a dummy variable used to capture individual effects experienced by Verizon.

RBELLS is a dummy variable used to capture individual effects experienced by BellSouth.

RPBELLS is a dummy variable used to capture individual effects experienced by Pacific Bell.

ANOVA - Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.181	8	1.023	22.108	.000(a)
	Residual	.971	21	.046		
	Total	9.153	29			

a. Predictors: (Constant), RSW, D2001, LPVG, RBELLS, D2000, RVZ, RAM, RPBELLS

b. Dependent Variable: LQVG

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.386	4.696		1.360	.188
	LPVG	-.458	1.015	-.062	-.452	.656
	D2000	-.667	.101	-.483	-6.581	.000
	D2001	-1.043	.102	-.755	-10.274	.000
	RAM	-.291	.138	-.196	-2.114	.047
	RVZ	-.465	.137	-.314	-3.394	.003
	RBELLS	-.763	.139	-.515	-5.484	.000
	RPBELLS	-.474	.214	-.319	-2.211	.038
	RSW	.084	.149	.057	.563	.580

a. Dependent Variable: LQVG

The estimated elasticity for DS-0 is insignificant.

Appendix 6

Investment Share of National Output

(In Trillions of Dollars) - US Domestic Economy

	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>
Propensity to Invest				
Investment Expenditures	\$ 2.3	\$ 2.2	\$ 2.2	\$ 2.4
Materials and Services Expenditures	\$ 6.1	\$ 6.2	\$ 6.2	\$ 6.4
Total Investment & Materials and Services Expenditures	\$ 8.4	\$ 8.4	\$ 8.4	\$ 8.8
Investment Shares	27%	26%	26%	27%

Appendix 7

Macroeconomic Model - A General Description

The following provides a general description of a simple macroeconomic model, obtained from the website of Yale professor Ray Fair at <http://fairmodel.econ.yale.edu/index.htm> – Section 1.1. The econometric model described on the website was not used in this analysis.

“A macro econometric model like the US model is a set of equations designed to explain the economy or some part of the economy. There are two types of equations: *stochastic*, or *behavioral*, and *identities*. Stochastic equations are estimated from the historical data. Identities are equations that hold by definition; they are always true.

There are two types of variables in macro econometric models: *endogenous* and *exogenous*. Endogenous variables are explained by the equations, either the stochastic equations or the identities. Exogenous variables are not explained within the model. They are taken as given from the point of view of the model. For example, suppose you are trying to explain consumption of individuals in the United States. Consumption would be an endogenous variable—a variable you are trying to explain. One possible exogenous variable is the income tax rate. The income tax rate is set by the government, and if you are not interested in explaining government behavior, you would take the tax rate as exogenous.

Specification

It is easiest to consider what a macro econometric model is like by considering a simple example. The following is a simple multiplier model. C_t is consumption, I_t is investment, Y_t is total income or GDP, G_t is government spending, and r_t is the interest rate. The t subscripts refer to period t .

$$(1) C_t = a_1 + a_2 Y_t + e_t$$

$$(2) I_t = b_1 + b_2 r_t + u_t$$

$$(3) Y_t = C_t + I_t + G_t$$

Equation (1) is the consumption function, equation (2) is the investment function, and equation (3) is the income identity. Equations (1) and (2) are stochastic equations, and equation (3) is an identity. The endogenous variables are C_t , I_t , and Y_t ; they are explained by the model. r_t and G_t are exogenous variables; they are not explained.

The specification of stochastic equations is based on theory. Before we write down equations (1) and (2), we need to specify what factors we think affect consumption and investment in the economy. We decide these factors by using theories of consumption and investment. The theory behind equation (1) is simply that households decide how much to consume on the basis of their current income. The theory behind equation (2) is that firms decide how much to invest on the basis of the current interest rate. In equation (1)

consumption is a function of income, and in equation (2) investment is a function of the interest rate. The theories behind these equations are obviously much too simple to be of much practical use, but they are useful for illustration. In practice it is important that we specify our equations on the basis of a plausible theory. For example, we could certainly specify that consumption was a function of the number of sunny days in period t , but this would not be sensible. There is no serious theory of household behavior behind this specification.

e_t and u_t are error terms. The error term in an equation encompasses all the other variables that have not been accounted for that help explain the endogenous variable. For example, in equation (1) the only variable that we have explicitly stated affects consumption is income. There are, of course, many other factors that are likely to affect consumption, such as the interest rate and wealth. There are many reasons that not all variables can be included in an equation. In some cases data on a relevant variable may not exist, and in other cases a relevant variable may not be known to the investigator. We summarize the effects of all of the left out variables by adding an error term to the equation. Thus, the error term e_t in equation (1) captures all the factors that affect consumption other than current income. Likewise, the error term u_t in equation (2) captures all the factors that affect investment other than the interest rate.

Now, suppose that we were perfectly correct in specifying that consumption is solely a function of income. That is, contrary to above discussion, suppose there were no other factors that have any influence on consumption except income. Then the error term, e_t , would equal zero. Although this is unrealistic, it is clear that one hopes that consumption in each period is mostly explained by income. This would mean that the other factors explaining consumption do not have a large effect, and so the error term for each period would be small. This means that the variance of the error term would be small. The smaller the variance, the more has been explained by the explanatory variables in the equation. The variance of an error term is an estimate of how much of the left hand side variable has not been explained. In macroeconomics, the variances are never zero; there are always factors that affect variables that are not captured by the stochastic equations.

Equation (3), the income identity, is true regardless of the theories one has for consumption and investment. Income is always equal to consumption plus investment plus government spending (we are ignoring exports and imports here)."

Appendix 8

Macroeconomic Simulation Results by Industry Group

Increase in Gross Output by Industry Sector³⁶

In Billions of Dollars

Industry Description	SIC	2003	2004	2005
----------------------	-----	------	------	------

Manufacturing				
Food Products	20	0.30	0.57	0.60
Tobacco Products	21	0.01	0.02	0.02
Textile Mill Products	22	0.12	0.14	0.11
Apparel Products	23	0.09	0.03	-
Lumber & Wood Products	24	0.13	0.20	0.20
Furniture and Fixtures	25	0.31	0.37	0.35
Paper & Allied Products	26	0.12	0.24	0.23
Printing & Publishing	27	0.27	0.43	0.40
Chemical Products	28	0.22	0.53	0.54
Petroleum Refining	29	0.16	0.33	0.34
Rubber & Plastics Prod.	30	0.19	0.32	0.28
Leather & Products	31	0.02	0.03	0.01
Stone, Clay, & Glass	32	0.11	0.22	0.21
Primary Metal Industries	33	0.17	0.36	0.31
Fabricated Metal Industries	34	0.27	0.47	0.41
Industrial Machinery	35	1.73	2.54	2.05
Electrical Machinery	31	0.57	0.97	0.77
Transportation Equipment	37	0.53	0.85	0.16
Instruments & Related Prod.	38	0.05	0.06	0.00
Miscellaneous Durable Prod.	39	0.15	0.24	0.22

Non-Manufacturing				
Agriculture	AGR	0.17	0.29	0.29
Construction	C	1.60	2.56	2.46
Finance, Insurance, Real Estate	FIR	1.90	2.96	2.97
Mining	MIN	-	0.10	0.11
Services	SVO	4.25	6.34	6.02
Retail Trade	TR	1.65	2.58	2.38
Transportation & Utilities	TRTPU	19.29	24.22	23.00
Wholesale Trade	TW	1.20	1.74	1.54

Total Gross Output		35.58	49.69	45.98
Total Employment Gain		64,000	132,000	130,000

³⁶ Gross output gains (value of total shipments) are relative to the baseline economic scenario.

Percent Increase in Gross Output by Industry Sector³⁷

Industry Description	SIC	2003	2004	2005
Manufacturing				
Food Products	20	0.06%	0.10%	0.11%
Tobacco Products	21	0.04%	0.10%	0.10%
Textile Mill Products	22	0.17%	0.21%	0.17%
Apparel Products	23	0.12%	0.05%	0.00%
Lumber & Wood Products	24	0.14%	0.22%	0.21%
Furniture and Fixtures	25	0.51%	0.59%	0.54%
Paper & Allied Products	26	0.08%	0.15%	0.14%
Printing & Publishing	27	0.15%	0.22%	0.20%
Chemical Products	28	0.06%	0.13%	0.13%
Petroleum Refining	29	0.08%	0.16%	0.16%
Rubber & Plastics Prod.	30	0.12%	0.19%	0.16%
Leather & Products	31	0.29%	0.47%	0.14%
Stone, Clay, & Glass	32	0.13%	0.23%	0.21%
Primary Metal Industries	33	0.10%	0.19%	0.16%
Fabricated Metal Industries	34	0.12%	0.20%	0.17%
Industrial Machinery	35	0.19%	0.24%	0.18%
Electrical Machinery	31	0.13%	0.19%	0.14%
Transportation Equipment	37	0.09%	0.15%	0.03%
Instruments & Related Prod.	38	0.03%	0.03%	0.00%
Miscellaneous Durable Prod.	39	0.23%	0.34%	0.30%
Non-Manufacturing				
Agriculture	AGR	0.06%	0.10%	0.10%
Construction	C	0.21%	0.32%	0.29%
Finance, Insurance, Real Estate	FIR	0.07%	0.11%	0.11%
Mining	MIN	0.00%	0.07%	0.08%
Services	SVO	0.13%	0.18%	0.16%
Retail Trade	TR	0.11%	0.17%	0.15%
Transportation & Utilities	TRTPU	1.36%	1.66%	1.52%
Wholesale Trade	TW	0.14%	0.19%	0.16%

³⁷ Gross output gains (value of total shipments) are relative to the baseline economic scenario.